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G. Tertnes, N. Losnegard, and E. Langmyhr

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STUDIES ON THE QUALITY OF FISH HELD IN CHILLED SEAWATER AND IN ICE
PART Vb

By

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EXAMINATION OF THE QUALITY OF FISH STORED IN CHILLED SEA WATER AND IN ICE ; V b

SUMMARY

Bled, round small pollock (Pollachius virens) was stored in chilled seawater (RSW) and in ice for up to 13 days.

Samples were taken at various times during the storing and examined by sensory, chemical, and bacteriological methods. Samples were taken for analyses immediately after the trial was concluded and after refrigeration for one year.

The first part of the study is described in Report No. 8/83, Reports and Notes (1) of the Directorate of Fisheries. This report describes the samples after one year of refrigeration.

The sensory examination of cooked samples showed that all samples were given lower quality points than those judged before refrigeration and that consistency had the greatest effect on total impression in the case of fish stored for the shortest periods.

The tank-stored fish was judged to be significantly poorer than the ice-stored fish after periods of 6, 9, and 13 days. This is in compliance with the results obtained before refrigeration (1).

Levels of volatile nitrogen compounds corresponded to those obtained before refrigeration.

Dimethylamine was used as an indicator of refrigeration stress and showed an increase from the situation before refrigeration.

The bacterial load of the fish became smaller during the refrigeration. This means that bacteria were destroyed by freezing during the refrigeration period.

INTRODUCTION

This report contains Part 2 of an experimental project earlier described in Report No. 8, 1983 in the series Reports and Notes published by the Directorate of Fisheries (1). The project is the fifth in a series aimed at illuminating various factors of importance for the quality of fish being held in ice and in refrigerated seawater (RSW).

This report describes the results of an evaluation of the fish samples after one years cold storage by chemical, bacteriological and sensory criteria.

MATERIALS AND METHODS

The sample fish were divided into two groups according to handling methods:

B. Bled, round

C. Gutted, headed

About 600 kg from handling method B was held in a tank of about 1000 litres. In parallel with the tank storage, fish B and C were iced in separate boxes.

Fish C were handled according to Quality Regulations in effect and act as controls throughout the experiment.

Samples were taken after 1, 3, 6, 9 and 13 days. After each sampling the fish were headed, filleted and skinned and then immediately frozen.

One series of samples were analyzed immediately after the end of the experiment while one series was stored for one year at ca. -25 C before analysis.

METHODS

The analytical methodology is as described in Report from Experimental Project V and I (1, 3).

RESULTS AND DISCUSSION

Sensory analysis after one year's frozen storage.

The sensory evaluation of cooked samples was carried out by

a taste panel with 6 judges. A total of 5 test series were completed, one for each storage period. In addition to the stored samples, samples of fish that had been frozen completely fresh were also served.

Table 1. Quality points for cooked samples p.4

Holding time,days	Samples		
	Bi	Ci	Bt
0		6.6	
1	6.4	6.5	6.2
3	6.0	5.6	5.7
6	6.3	6.7	5.4
9	6.1	5.7	5.4
13	4.8	5.8	3.3

Bi = Round, bled fish, held in ice
Bt = Round, bled fish, held in tank
Ci = Gutted, headed fish, held in ice
The quality points in the table are averages for 6 judges.

Fish held for 3 days in ice are obviously being judged too low compared to fish held 6 and 9 days. All samples have received lower marks than they had before frozen storage. For all storage times, except for 13 days, texture was given lower marks than odor and taste.

In addition to the quality evaluation the fish were rated according to total quality.

Table 2. Rating of the samples.

Holding time days	Ranking 1	2	3
1	Bi	Bt	Ci
3	Ci	Bi	Bt
6	Ci	Bi	Bt
9	Bi	Ci	Bt
13	Ci	Bi	Bt

The sample designations are as for Table 1. The samples are arranged according to an increasing ranking, i.e. decreasing

quality. Samples that are not significantly different ($p < 0.05$) are underlined with the same line.

For samples stored 1 and 3 days there were no significant differences, but for samples held more than 6 days the tank held fish were judged significantly lower than the fish stored on ice.

Any salty flavor that may occur should not be taken into consideration in judging the quality, but should be evaluated separately.

p.5

Table 3. Salty flavor in the fish.

Holding time days	Samples Bi	Ci	Bt
0		0.0	
1	0.2	0.2	0.2
3	0.2	0.2	0.8
6	0.0	0.0	2.8
9	0.0	0.0	2.8
13	0.0	0.0	3.0

Salt was judged on the following scale:

0 = No salty flavor
1 = Indication of salty flavor (some doubt)
2 = Some salty flavor (no doubt)
3 = Obvious salty flavor

The values in the table represent the averages of 6 judges. The sample designations are as in Table 1.

Fish held for 3 days in a tank have received lower points than before frozen storage, while fish held 6 days received higher points (1). Otherwise the salty flavor has not changed substantially.

Chemical and bacteriological analyses of the fish after 1 year in frozen storage.

Table 4. TMAO-N and volatile nitrogen compounds.

Days in Tank	Ice	TMAO-N mg/100g		Tot.vol N mg/100g		TMA-N mg/100g.		DMA-N mg/100g		TMA-N (1) mg/100g.	
		B	C	B	C	B	C	B	C	B	C
0	0	35,3		11,8		0,5		2,4		0,1	
1	0	27,3		13,9		1,3		1,5		0,2	
3	0	28,8		15,0		1,6		2,8		0,3	
6	0	23,0		13,1		0,8		4,4		0,9	
9	0	24,0		12,6		2,3		3,4		1,9	
13	0	19,0		24,0		6,5		4,2		8,0	
0	1	29,0	31,0	13,5	12,8	1,6	0,9	1,7		0,3	0,3
0	3	28,8	30,2	11,1	9,0	0,8	0,4	2,9	2,5	0,2	0,3
0	6	23,4	28,6	10,8	14,0	1,3	0,8	2,1	3,0	0,3	0,3
0	9	27,3	27,0	14,8	12,0	0,7	0,9	2,9	3,4	0,5	0,4
0	13	23,3	24,0	16,3	10,3	3,1	2,0	5,6	4,2	2,2	1,3

1) Determined according to Bullard and Collins (2)

Table 4 shows the content of the volatile nitrogen compounds and TMAO-N in the fish after 1 years cold storage. There have only been small changes in the contents of TMAO-N, Tot. vol N and TMA-N relative to the values found before cold storage.(1)

DMA-N, which can usually be used as an indicator of frozen storage abuse, shows an increase relative to values found before cold storage.

Table 5. Hypoxanthine and drip- and press water. p.6

Days in Tank	Ice	Hypoxanthine mg/100 g.		Drip water and press water (D) (P) g/100 g.					
				B			C		
		B	C	D	P	D+P	D	P	D+P
0	0	12,9		9	32	41	9	32	41
1	0	15,9		10	23	33			
3	0	27,0		13	24	37			
6	0	21,0		10	25	35			
9	0	11,1		2	19	21			
13	0	19,2		4	17	21			
0	1	8,0	16,9	10	25	35	12	29	41
0	3	19,6	10,6	12	25	37	15	25	40
0	6	19,3	19,8	13	26	39	16	22	38
0	9	14,7	15,3	12	28	40	14	27	41
0	13	27,9	22,8	11	30	41	11	26	37

D- drip water
P -press water

The hypoxanthine content has increased noticably after frozen storage for bled, round fish (B) held 1 and 3 days in tank and for fish held 3, 6 and 13 days in ice. For gutted, headed fish (C) there is also an increase after 1 and 6 days holding in ice.

Also in fish that have been frozen directly is there a clear increase in the hypoxanthine content after 1 year in cold storage. The amount of drip water is considerably lower for fish held in tank for 9-13 days. This is probably due to the salt uptake.

Table 6. Bacteriological analyses of fillets.

Days in Tank	Ice	Total number live bacteria/g at 20 C B	C
0	0		300
1	0	3.400	
3	0	2.000	
6	0	2.600	
9	0	1.700	
13	0	5.100	
0	1	550	3.100
0	3	2.300	1.700
0	6	3.400	2.900
0	9	5.600	600
0	13	9.000	84.000

The values for total number of live bacteria is more an indication of sanitation during processing than of differences in quality between tank- and ice held fish. The bacterial count is very much lower than before cold storage.(1). This is probably due to freezer kill.

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